High tides in geological history.

In the review of the *Geographisches jahrbuch* for 1882, published in *Science*, No. 54, the notice of the contribution of Dr. Zöppritz on the progress of terrestrial physics contains the following words: —

"In commenting on Professor George Darwin's work on the effect of the tides upon the moon's distance, and on Mr. Ball's entertaining lecture, 'A glimpse through the corridors of time,' on the same subject, the reviewer accepts Professor Newberry's conclusion, that the moon must have already attained its actual distance from us when our oldest Cambrian and Silurian strata were deposited. This seems an unnecessary adherence to doctrines of uniformity: for, in the spread of our paleozoic strata, there is evidence of much stronger submarine transportation than we now find; and even in Jurassic times there is a surprising area of cross-bedded sandstones in the region of the Colorado plateau."

Those who have followed the discussion in *Nature*, of the theory of ancient high tides proposed by Professor Ball as a lesson to geologists, will perhaps remember that I declined to receive the lesson, and denied the existence of the imagined high tides, because the geological record not only contains no traces of such tides, but, on the contrary, supplies abundant evidence that no such violent action accompanied the formation of the sedimentary rocks. In making this statement I was not constrained by any devotion to uniformitarianism, as the reviewer intimates, but based my conclusions upon an unbroken series of *facts*. These facts prove that the accumulation of the paleozoic rocks took place in conditions essentially like those which prevail at present, and show conclusively that the statement, "that in the spread of our paleozoic strata there is evidence of much stronger submarine transportation than we now find," is unwarranted. As that statement and those I have made are in direct conflict, and the question involved is an all-important one in the reading of geological history, I take the liberty of reviewing briefly the evidence on which my conclusions were based.

In the Cambrian age were laid down, along the eastern margins of our continent, the Acadian shales of New Brunswick, the Olenellus shales of Vermont, the shales and limestones of Troy, and the shales (now siliceous slates) of Braintree, Mass., — all the products of quiet deposition. In the Mississippi valley the Cambrian strata are buried, and inaccessible to us. In the Lake Superior region the copper series was probably deposited in the Cambrian age, although demonstration of this has not been obtained. There volcanic disturbances and eruptions produced great activity in the agents which form mechanical sediments, — conglomerates, sandstones, and shales; but this violence was all local, as we find no traces of it outside that area. In the far west the Cambrian rocks are well exposed in many places, and constitute twelve thousand feet of shales, with one stratum of limestone in the section of the Colorado Cañon, seven thousand feet in Nevada, and twelve thousand feet in the Wasatch, of sandstones, shales, and limestones, according as deposited under inshore, offshore, or open-sea conditions, but nowhere showing marks of more violent action than may be observed to-day.

In the lower Silurian rocks we have the record of a great continental subsidence, or elevation of the ocean-level; the advance of the sea upon the land; and the spread of a sheet of sea-beach material — the Potsdam sandstone — as far as the invasion extended. But the Potsdam beach was precisely like the beaches of to-day, — ripple-marked, sun-cracked, bored by annelids, strewed with seaweeds, and abounding in the entire or broken shells of beach-inhabiting brachiopods. Above this we have the organic deposits made by the Silurian sea when it stood over the submerged territory, — a thousand feet or more of limestones. Then the Hudson River and Utica shales were laid down in the shallower waters of the retreating sea. Here we have a complete history of the physical conditions which prevailed during the formation of the lower Silurian rocks, but nowhere find any traces of the high tides of Professor Ball's interesting but imaginative lecture.

A similar round of deposits composed the upper Silurian, the Devonian, and the carboniferous systems. Each group of rocks tells its own story so clearly that a child may comprehend it; and that story is not only without any high-tide episode, but is clearly and positively contradictory to the high-tide theory.

Your reviewer cites no facts to sustain his statement, and there are none. The cross-bedded mesozoic sandstones of the Colorado plateau have, of course, no bearing upon it, and they afford no support to the high-tide theory: they simply show that peculiar conditions prevailed in the triassic age over a limited area on the east side of the Wasatch, where a shallow sea was moved with strong currents, tidal or otherwise. On the west side of the land which separated this ancient Bay of Fundy from the Pacific, the triassic and Jurassic strata show no such violent action; and the same may be said of other parts of the world. The records of the cretaceous age, which are the most complete and completely exposed to view of any, are the most conclusive in their demonstration of the absence of violent and abnormal action in the processes of nature.

I may also call the attention of your reviewer to the fact that Prof. G. H. Darwin, whose study of the physical structure and history of the system of Mars was the inspiration of Professor Ball's lecture, declines to subscribe to his conclusions, and concedes that there is no evidence of abnormally high tides since the beginning of the paleozoic ages.

J. S. Newberry.

The flora of Labrador.

A contributor to No. 59 tells us that "I have endeavored to show that we must look to the north for the place of origin of many of our plants," and that he "can see further reason for the assertion" in an analysis which he makes of a very incomplete list of the flora of Labrador. He further teaches us, —

"That many of these plants were at one time distributed all around the Arctic circle, there can be no doubt; and that they have been driven from their first homes by the excessive cold, and found suitable abiding-places at the south, must also be considered as an established fact."

Now, Mr. Editor, is not all this so well established and so familiar as to render superfluous the *endeavor to show it* in the form of a contribution to *Science?* Whatever may be said upon the question 'where did life begin?' considered deductively, there is no longer any doubt as to where the vegetable life around us came from; nor does your contributor throw any new light upon the matter, in the column which he fills.

Botanicus.

How do the winds blow within the storm-disk?

The following method of showing graphically and concisely the result of many observations on storm-winds may, on account of its simplicity, prove of value to students of meteorology. Synchronous observations of winds charted on weather-maps for any single epoch are generally too few and often too discordant to give a precise picture of the spiral course followed by the whirling air; and it is difficult to combine by

eye-memory the observations plotted on several separate charts. But this combination can be made easily and accurately by taking off the records of successive dates on a single sheet of tracing-paper. A cross on the paper marks the storm-centre, always to be placed on the middle of the area of low pressure; and a north line, laid parallel to the meridians, serves as a means of orientation. A large number of observations may thus be transferred to a single figure, and every one of them falls in its proper position with respect to the centre of the storm.

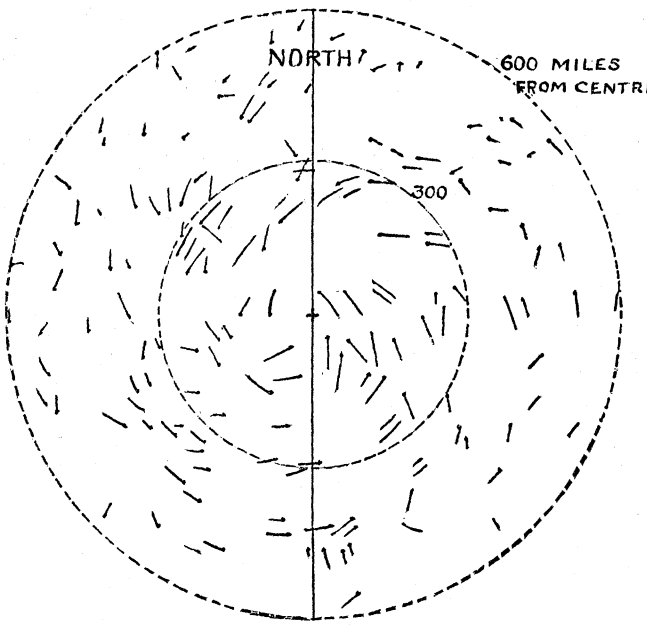

FIG. 1.

The synchronous charts of the North Atlantic for August, 1873, prepared by Capt. Toynbee of the British meteorological office, yield a hundred and fifty-seven wind-records within six hundred miles of the centre of a cyclone that passed from the West Indies along our coast in the ten days from the 18th to the 27th of that month. These are all brought into the accompanying diagram (fig. 1), which shows very clearly, first, that the stronger winds are nearly all inside the circle of three hundred mile radius, where the longest arrows represent hurricane violence, or twelve of the Beaufort scale; and, second, that these winds have, with notably few exceptions, a distinct departure from a circular path to an incurving spiral. Very evidently, therefore, the centre of this storm would not bear 'about eight points' to the left of the wind's course, as the older mariner's guides put it, but generally about six, or in some cases even as little as four, points to the left, as has been shown in many other examples.

Fig. 2 shows the result of similar treatment of several days' records of storm-winds in our northern states, as mapped in the Signal-service daily bulletins for October, 1877. Observations north of the centre are unfortunately rare, as we have not as yet sufficient stations in the British possessions. Although the three hundred arrows show numerous discordant directions, the general motion indicated by them is again clearly an incurving spiral.

This method of concentrating observations on a single diagram may prove of service in several directions of storm-study, being applicable to the determination of the general form of isobars, and areas of cloud and rain, as well as to the investigation of the inclination and velocity of the wind in different quadrants of the storm, or at stations of different situation as to distance from the coast-line, or elevation above sea-level.

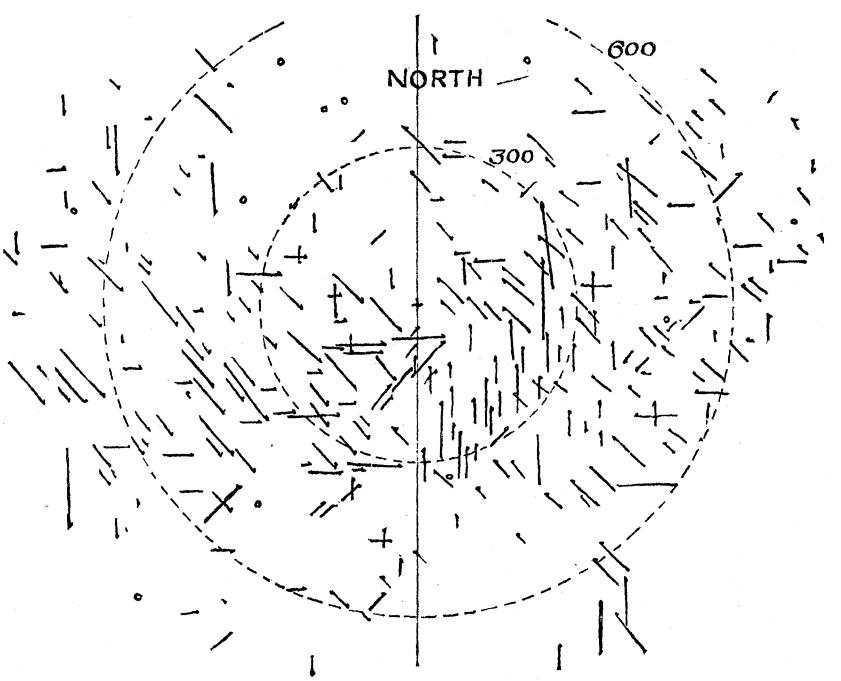

FIG. 2.

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